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April 5, 2005

VIA ELECTRONIC FILING
Marlene H. Dortch, Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, DC 20554

RE: In the Matter of the Development of Operational, Technical, and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communication Requirements Through the Year 2010
WT Docket No. 96-86
Ex Parte Presentation

Dear Ms. Dortch:

On behalf of Dataradio Inc., and in accordance with Section 1.1206(b) of the Commission's Rules, 47 C.F.R. § 1.1206(b), undersigned hereby submits the instant notice of an *ex parte* presentation.

On March 31, 2005, I, Robert T. Rouleau, along with Ray Pache and Andrew Middlebrooks of Dataradio, Inc., met with Michael Wilhelm and Timothy Maguire, both of the Public Safety and Critical Infrastructure Division of the Wireless Telecommunications Bureau, to discuss the ACP limits and interoperability requirements proposed in the 7th Notice of Proposed Rulemaking in WT Docket No. 96-86. Attached is a copy of the White Paper presented at that meeting.

We apologize for the inadvertent late filing of this notice. Please refer any questions to my attention.

Very truly yours,

/s/

Robert T. Rouleau
President and CEO
Dataradio Inc.

cc: Chief Michael J. Wilhelm
Timothy Maguire

COMMENTS ON THE PROPOSED ACP LIMITS AND INTEROPERABILITY REQUIREMENTS OF THE 7TH NPRM

Dataradio Inc.
March 29th, 2005

I. INTRODUCTION

The Federal Communications Commission (FCC) has recently issued a 7th Notice of Proposed Rulemaking[1] (7th NPRM) that addresses the use of the 700 MHz spectrum allocation for public safety radio. In the 7th NPRM, the FCC has asked for comment on the following proposed changes to the rules among others:

(a) A proposal made by the Private Radio Section of the Wireless Communications Division of the Telecommunications Industry Association (TIA-PRS) to: adopt tables describing ACP limits for 50 kHz and 100 kHz wideband operations; relax the ACP requirement in the paired receive band for wideband and narrowband base station transmitters; and extend the ACP limits to the 700 MHz Guard Band channels.

(b) Proposals made by the Public Safety National Coordination Committee (NCC) asking that the Commission adopt a 700 MHz wideband data standard; require that wideband mobile and portable radios be capable of operating on all the wideband interoperability channels using the wideband data standard; update the interoperability standards set forth at Section 90.548 of the Commission's rules to reflect updated industry standards; and adopt minimum signal strength design criteria for public safety systems operating in the 700 MHz Public Safety Band.

In Section II we summarize our comments, and the basis for these comments is described in detail in the following Sections III and IV.

II. EXECUTIVE SUMMARY

While we feel the intent of the proposed changes to the Commission's rules is good, we believe that the proposed changes are insufficient to guarantee reliable use of these frequency bands for public safety. In particular:

[1] FCC WT Docket No. 96-86. Fifth Memorandum Opinion and Order, Sixth Report and Order, and Seventh Notice of Proposed Rulemaking, Doc. No. FCC-05-9A1, adopted January 5, 2005; released January 7, 2005.

a) We feel the proposed ACP limits for 50 kHz and 100 kHz are lax and will lead to excessive co-channel interference and result in an interference-limited system. In particular:
    1. The proposed ACP limits apparently take little account of the near-far issues in land-mobile radio and are only marginally more stringent that those for satellite communications.[2]
    2. This interference limitation may be compensated with additional infrastructure much like the current cellular system but these infrastructure requirements are a hidden cost that the public safety community can ill-afford.
    3. The proposed ACP limits will permit excessive interference over a wide frequency range; potentially allowing one transmitter to compromise the performance of all wideband interoperability channels.

b) While the concept of interoperability is good, care must be taken that any proposed standard is economically viable. We feel the proposed wideband TIA.902 (SAM) standard has numerous shortcomings and that it would be ill-advised to make it a requirement. In particular:
    1. The nature of the SAM signal-in-space we believe is behind the loose ACP limits proposed by the NCC. In particular, it may not be economically possible to produce a SAM radio which meets tighter ACP requirements. The implication being that what one doesn't pay for in the radio, one pays for many times over in the infrastructure.
    2. The proposed SAM standard is almost the same as, if not identical to, the Commercial Mobile Radio Service (CMRS) "Direct-Connect" offered by Nextel in the 800 MHz band. It is well known that the interference between Nextel users and safety users led to the very knotty problem of re-banding at 800 MHz. We believe that the experience at 800 MHz is indicative of what will happen to safety services at 700 MHz if this standard is chosen.
    3. Regarding proposed NCC design parameters regarding minimum signal strength, we are concerned that this proposal is almost exactly the same request made by Nextel for public safety users when Nextel was requesting re-banding the 800 MHz band[3]. The ostensible reason is that it will alleviate interference for public safety users. It begs the question: is the system so poorly designed to begin with that we are already anticipating interference problems?

[2] Rec. ITU-R.M1480; 47 CFR 25.202

[3] "Nextel 800 MHz Interference Plan," Nextel White Paper submitted to FCC, 21 November 2001.

III. INTERFERENCE ANALYSIS

In this section we address the proposed ACP limits for 50 and 100 kHz wideband transmitters using the 700 MHz band. For convenience, we have reproduced one of the tables describing the proposed limits below, although our comments apply to all proposed ACP tables in the 7th NPRM.

50 kHz Mobile Transmitter ACP Requirements

Offset from Center Frequency (kHz)	Bandwidth (kHz)	Maximum ACP (dBc)
50	50	-40
100	50	-50
150	50	-50
200	50	-50
250	50	-50
300	50	-50
350	50	-50
400	50	-50
450	50	-50
500	50	-50
550	50	-50
600 to 1000	30 (s)	-60
1000 to 2000	30 (s)	-65
2000 to 9000	30 (s)	-70
9 MHz to paired receive band	30 (s)	-70
In the paired receive band	30(s)	-100

At issue are the -40 dBc and -50 dBc adjacent channel power (ACP) limits from 50 kHz to 550 kHz on either side of the mobile transmitter center frequency in the above table. We feel these high limits lead to excessive adjacent channel interference. For the base station, the ACP limits are somewhat more stringent but they still permit ACP of up to -40 and -50 dBc in the first 250 kHz on either size of the transmission center frequency.

To evaluate the effect of these ACP limits, we performed an analysis of the carrier-to-interference ratio (*C/I*) under various operational scenarios. The analysis makes the following assumptions:

- The first assumption is that land-mobile propagation can be reasonably modeled using the Hata-Okamura model.[4] This well-known model has been used extensively for predicting median signal levels as a function of distance from the base station. This model takes into account factors such as frequency, antenna heights, nature of the local geography (urban, suburban, or rural).
- The second assumption is that variations about the median signal level can be model with as a log-normal distribution. The variance of this distribution also

[4] Parsons (The Mobile Radio Propagation Channel, Wiley,1992), Rappaport (Wireless Communications, Prentice-Hall,1996), and Haykin and Moher (Modern Wireless Communications, Prentice-Hall, 2005).

depends upon the local geography. This well-known model is sometimes referred to as slow fading or log-normal shadowing.[5]

For example, the received signal levels predicted by the model for a small to medium-sized city with a 300 watt transmitter transmitting from a 50 meter tower are illustrated in Figure 1. Figure 1 includes both median signal levels and the levels for 99% availability using the log-normal shadowing model. The conclusion is that, in an interference-free environment, a single tower can service a considerable area even when 99% availability is required.

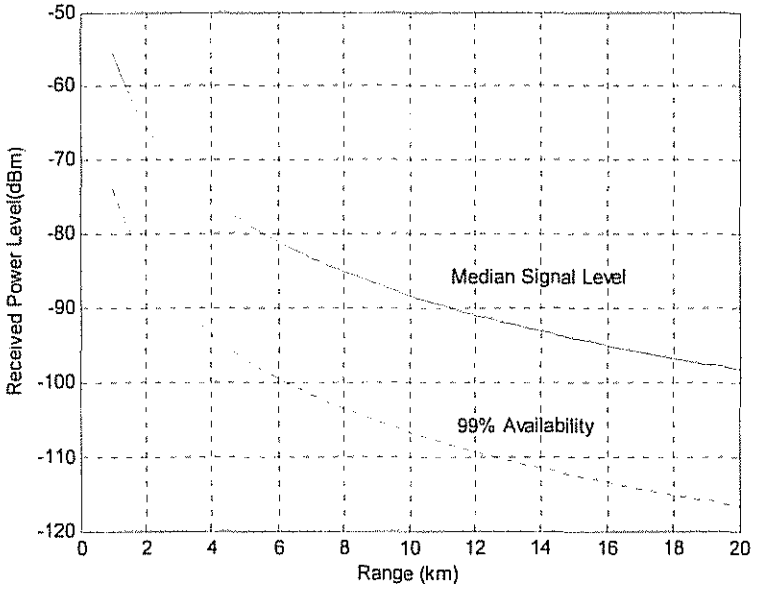

Figure 1. Received power levels using Hata-Okamura propagation model of a medium-sized city.

In what follows we will present *C/I* contours for a given service area based on the above propagation models. These contours are also specified at 99% availability; that is, outside a contour labeled *X*, the *C/I* ratio is greater than *X* dB in 99% of the locations. We will present the contours for a number of scenarios but to minimize the number of results we concentrate on performance predicted for small to medium-size cities.

To illustrate the approach, consider the *C/I* contour plot of Figure 2. This corresponds to the *C/I* seen be receiver as a function of position with respect to two base stations; Tx 'o' is the desired transmitter, Tx "x" is transmitting at a similar power level in an adjacent channel. The base stations are separated by 3 km and the transmitting antennas are atop 50 meter towers. In Figure 2, the *x*- and *y*-axes are simply distance on 20 km by 20 km square; the contours are spaced at 2 dB increments and the labels on the contours are the respective *C/I* levels. The adjacent channel power (ACP) is -40 dBc.

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[5] Ibid.

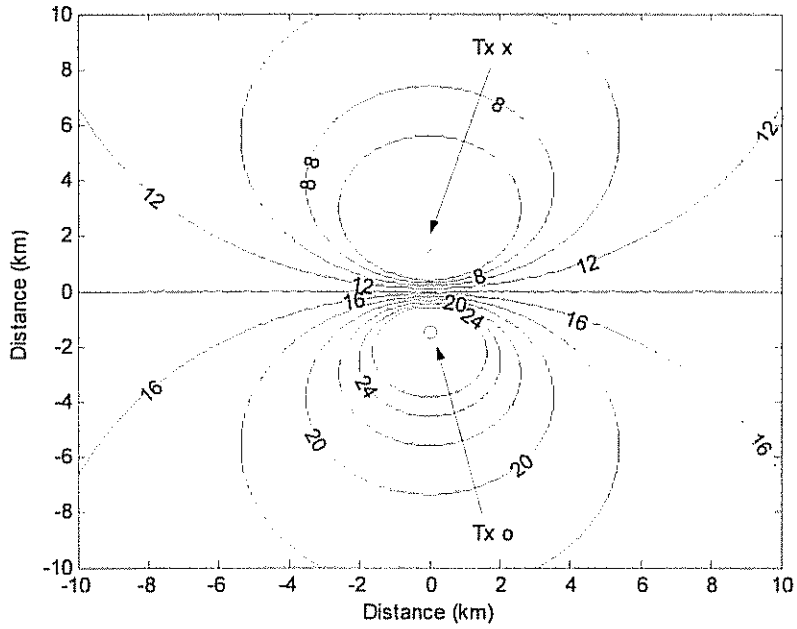

Figure 2. The *C/I* contours for 99% availability with one adjacent channel transmitter with -40 dBc ACP at 3 km, in a medium-sized city environment.

The immediate observation from Figure 2 is that the *C/I* is good in a one to two kilometer circular area surrounding the transmitting tower. The *C/I* rapidly degrades outside this area; half of the service area has a *C/I* of 14 dB or less.

As a comparison point for this analysis, we include the following table of performance for several well-known modulation techniques; these modulation techniques also happen to be part of the SAM proposal for the wideband interoperability standard. What is clear from Table 1 is that as the modulation order increases from QPSK to 64-QAM (i.e. spectral efficiency increases) there is also a significant increase in the required signal-to-noise ratio. This occurs both with and without forward-error-correction coding.

If interference is the major impairment then the levels in Table 1 become the threshold signal-to-interference ratio as well. In traditional systems, a *C/I* of 20 dB is reasonable. However, Table 1 implies that a *C/I* of 20 dB would be just sufficient to support the 230 kbps coded data service, if there were no other impairments. For a non-interference-limited system, the *C/I* should be 5 to 10 dB higher than this, for example, it would be reasonable to require a *C/I* of at least 24 dB.

SAM Raw Data Rate (kbps) 50 kHz channel	Modulation	Threshold SNR[6] (dB) (uncoded)	Threshold SNR (dB) (coded[7])
76.8	QPSK	12.6	4.2
153.6	16-QAM	20.5	10.7
230.4	64-QAM	31.8	18.7

Table 1. Ideal performance of various modulation techniques with and without forward error correction coding.

If the ACP limits are lowered to -50 dBc then the *C/I* contour plot shown in Figure 3 is obtained. In this case, the desired *C/I* of 24 dB is obtained over half of the service area. The other half of the service area would be interference-limited and would have reduced service. If the ACP requirements are further strengthened to -60 dBc, then the 14 dB contour in Figure 3 becomes the 24 dB contour and there is only a small area around the interfering tower where the service is interference-limited.

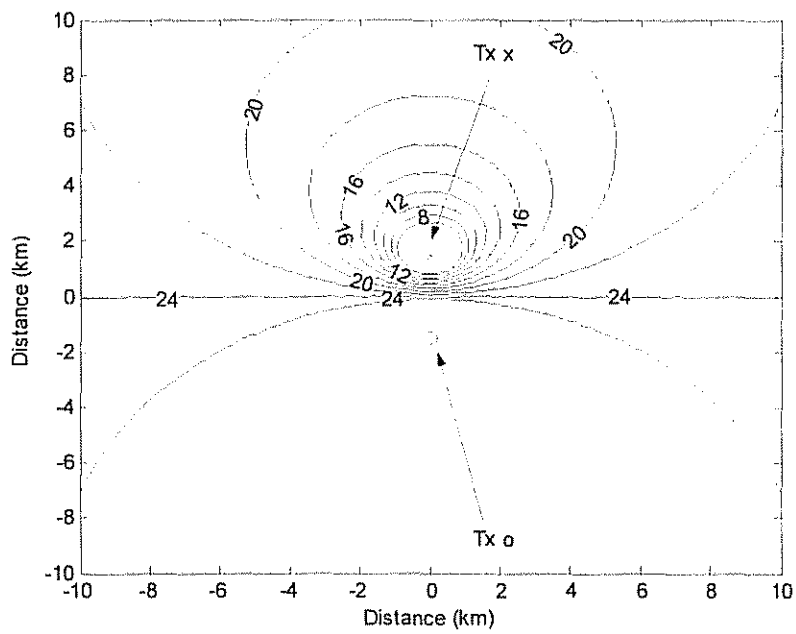

Figure 3. The *C/I* contours for 99% availability with one adjacent channel transmitter with -50 dBc ACP at 3 km, in a medium-sized city environment.

These *C/I* contour plots clearly demonstrate the shortcomings of the proposed ACP limits. Due to the reciprocal nature of propagation, these results apply in both the mobile-to-base direction and in the base-to-mobile direction. There are five additional points we wish to emphasize:

[6] Bit error rate of 10^{-5}

[7] Assumes rate ½ constraint-length 7 convolutional code for forward error correction with target bit error rate of 10^{-5}

a) If the desired transmitter is located inside a building, while the interfering transmitter is outside, then the desired transmitter will suffer a further attenuation, and the *C/I* will be reduced by the building attenuation. This would further exacerbate the *C/I* problem.
b) If there is more than one interfering transmitter, then the interference is compounded and performance is further degraded. This is not an unlikely situation given the number of adjacent 50 kHz channels with ACP limits of -50 dBc or higher.
c) The performance in other propagation environments is qualitatively similar to that shown above although the exact location of the contours depends upon the model.
d) In urban environments, the interference may compensated by installing more base stations. In urban environments, such base stations may be necessary in any event to service the lower-power portable terminals. In rural environments, the propagation conditions can be relatively good and one base station would be traditionally expected to service a very large area. The installation of extra base stations is a large capital expenditure considering the relative small user population for rural applications.
e) In total, 2.6 MHz of the 700 MHz public-safety spectrum is allotted to interoperability channels.[8] Of this, 1.8 MHz is designated for wideband interoperability channels; 0.9 MHz in each direction. Since the ACP limit of -50 dBc extends to 550 kHz on either side of the desired mobile channel, this implies that one transmitter could compromise the performance of all 700-MHz wideband-interoperability channels, and potentially other channels outside the interoperability spectrum, as well.

To illustrate point b), consider the case of two equal-power interfering transmitters with -50 dBc ACP as shown in Figure 4. The interfering transmitters are located 2 and 3 km from the desired transmitter respectively. In this case, there is a large area where *C/I* is 18 dB or less.

[8] FCC WT Docket 96-86, Second Memorandum Opinion and Order, adopted July 21, 2000; released August 1, 2000.

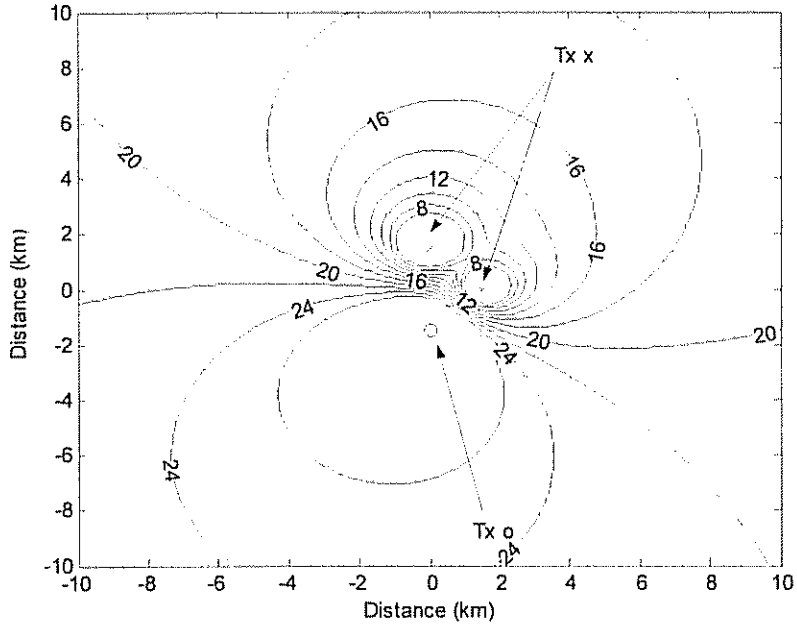

Figure 4. The *C/I* contours for 99% availability with two adjacent channel transmitters at 2 and 3 km, in a medium-sized city environment. Each interfering transmitter produces -50 dBc ACP.

IV. INTEROPERABILITY STANDARD

The second area of comment is regarding the mandating of TIA-902 (SAM) standard as a requirement for radios using the wideband interoperability channels.[9] We have three concerns in this area:

a) The first concern is regarding the out-of-band emissions with this standard. The proposed standard is essentially the same as that used in Nextel's "Direct Connect" CMRS service. Experience with the Direct-Connect service in the 800 MHz, where commercial service was interleaved with public safety channels, indicated significant interference problems that eventually led to the re-banding of the 800 MHz public safety channels. There is no reason to believe that this problem has gone away, but rather will re-appear again in the 700 MHz channels. However, in this case, it will be public safety channels interfering with public safety channels.

b) The second concern is with the range (i.e., radio coverage) of the proposed SAM standard. The proposed modulation technique is multi-carrier in nature, requiring highly linear amplifiers. This limits the power output and therefore the range of these new mobile wideband transmitters. In a commercial scenario, this could be remedied by installing more base stations, but this is not a viable option for a

[9] Paragraphs 50 and 53 of 7th NPRM

cash-strapped public safety service. Consequently, the benefits of these new wideband channels will be limited to urban centers close to the base station. Rural areas will likely be unable to use this new means of support.

c) The third concern we have with the proposed TIA 902 (SAM) standard is the quality of the standard. In particular, the standard leaves many parameters unspecified; identifies various modes of operation but does not indicate which are mandatory and which are optional; identifies several operational configurations but does not indicate which must be supported; and so on. Our concern is that equipment built to this standard by different manufacturers will likely not be interoperable due to the ambiguities in the standard.

While we agree with the FCC opinion[10] that a separate standard for rural and urban applications will lead to confusion and may not realistically meet the interoperability objective, we make the observation the proposed TIA-902 (SAM) standard is not single transmission scheme. Rather the standard is a family of modulation strategies and rates, one of which is selected based on the propagation conditions. The difficulty is that none of the members of the SAM family are suited to long-range, low-density applications.

V. CONCLUSIONS

Our conclusions are twofold:

a) The ACP limits should be reduced to at least –60 dBc in the channels surrounding the mobile and base station center frequencies. The possible exception to this is the nearest adjacent channel where such a limit may not be attainable at reasonable cost. However, it should be realized that a higher ACP limits effectively reduces the ability to use the adjacent channel and reduces overall spectral efficiency.

b) The mandatory part of the wideband interoperability standard should be a transmission strategy this is suitable for universal application, that is, for both high-density urban, and long-range, low-density rural applications.

[10] FCC WT Docket 96-86, Second Memorandum Opinion and Order, adopted July 21, 2000; released August 1, 2000